Comparison of SW flux profiles from CERES TRMM and Hadley GEM

Wenying Su
Science Systems Applications Inc. Hampton VA

Alejandro Bodas
Met Office, Hadley Center for Climate Change, Exeter UK

Tom Charlock
NASA Langley Research center, Hampton VA

Data

- CERES TRMM FSW: monthly gridded radiative fluxes and clouds;
- Hadley Center Global Environmental Model: AMIP (Atmospheric Model Intercomparison Project) run;
- July 1998: clear and all sky.

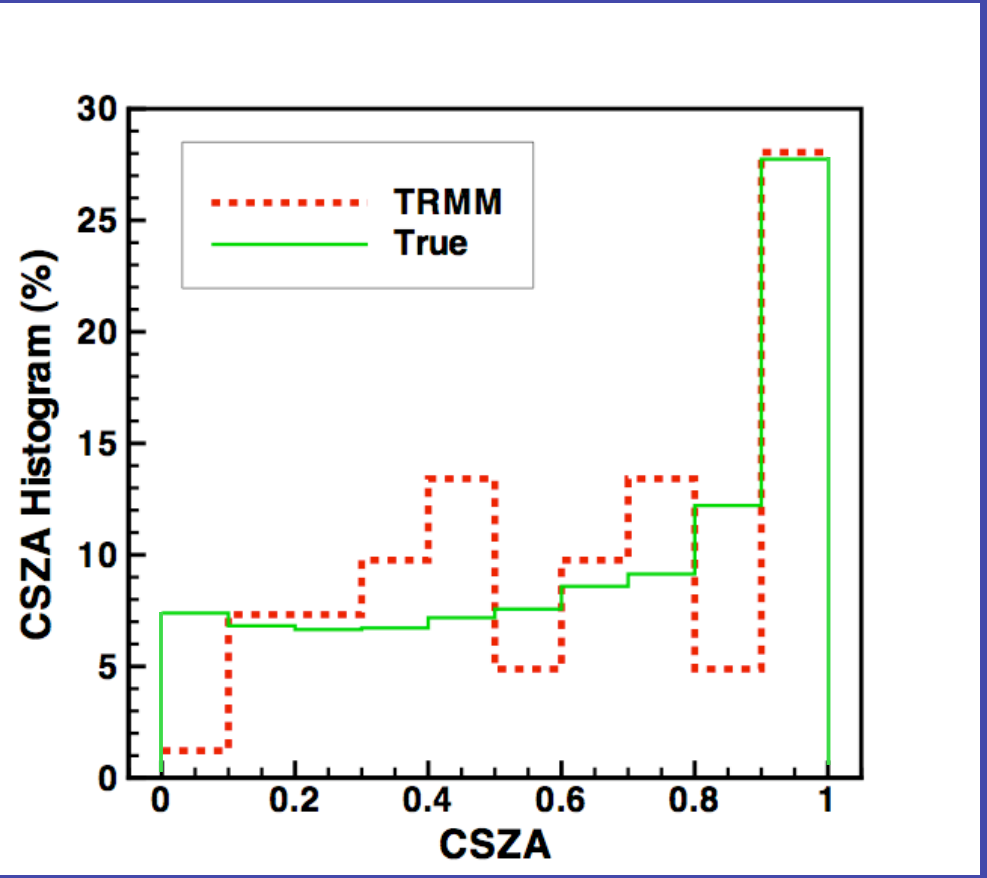
TRMM Diurnal Sampling Adjustment

- To adjust the TRMM diurnal sampling issue, for each CSZA bin:

$$\alpha_{bin} = \frac{True\_CSZA_{bin}}{TRMM\_CSZA_{bin}}$$

- Monthly mean flux:

$$\overline{F} = \frac{1}{N}\sum_{i=1}^{N} F_i^{bin}\alpha_{bin}$$



TRMM Diurnal Sampling Adjustment (cont'd)

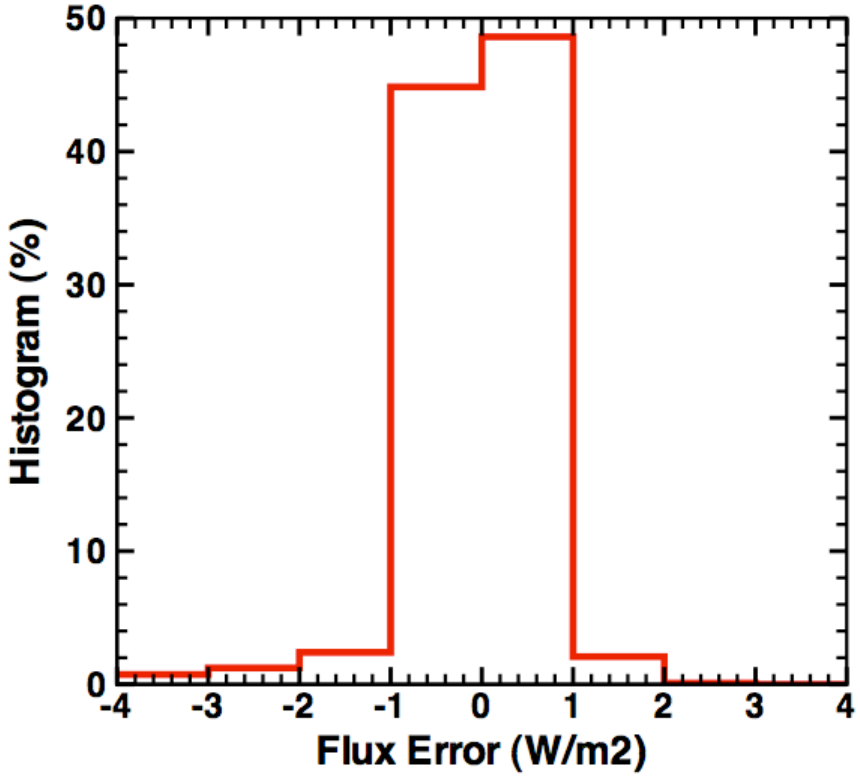
- The CSZA weighting is not perfect;
- The TOA SW downwelling flux for a given latitude still fluctuates a few watts across the longitude;
- Introducing a factor to scale the TRMM FSW TOA downwelling flux to be equal to that of Hadely GEM.

Validity of the Method

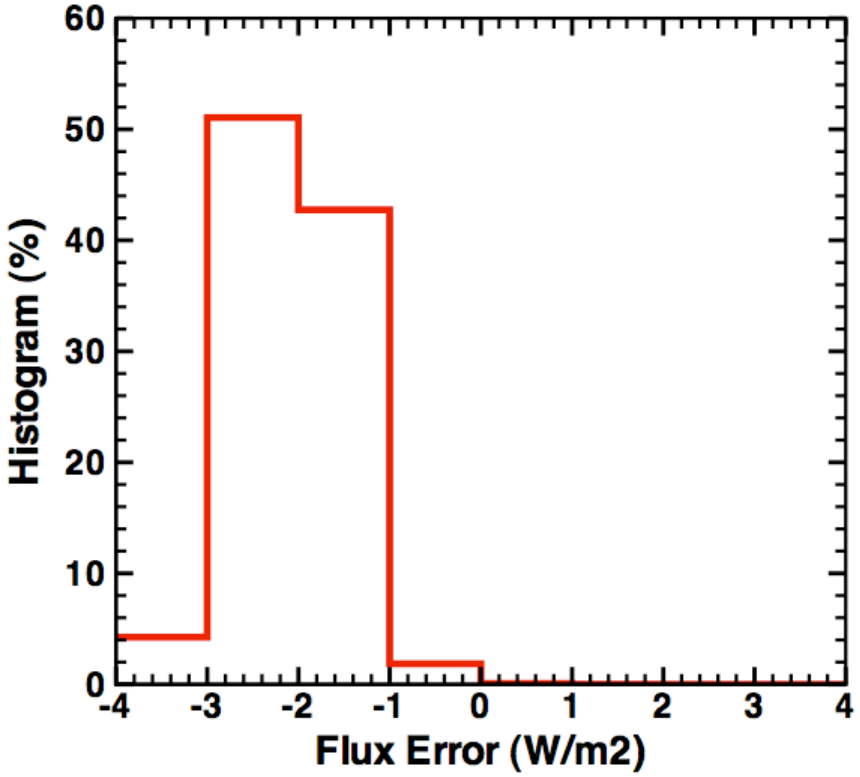
- The true monthly mean: run Fu-Liou model every 10 minutes for a month for clear and cloudy conditions;
- The TRMM-style monthly mean: randomly pick a few samples every day from the Fu-Liou model runs;
  - Sample number ranging from 60 to 300;

Flux Difference Histogram

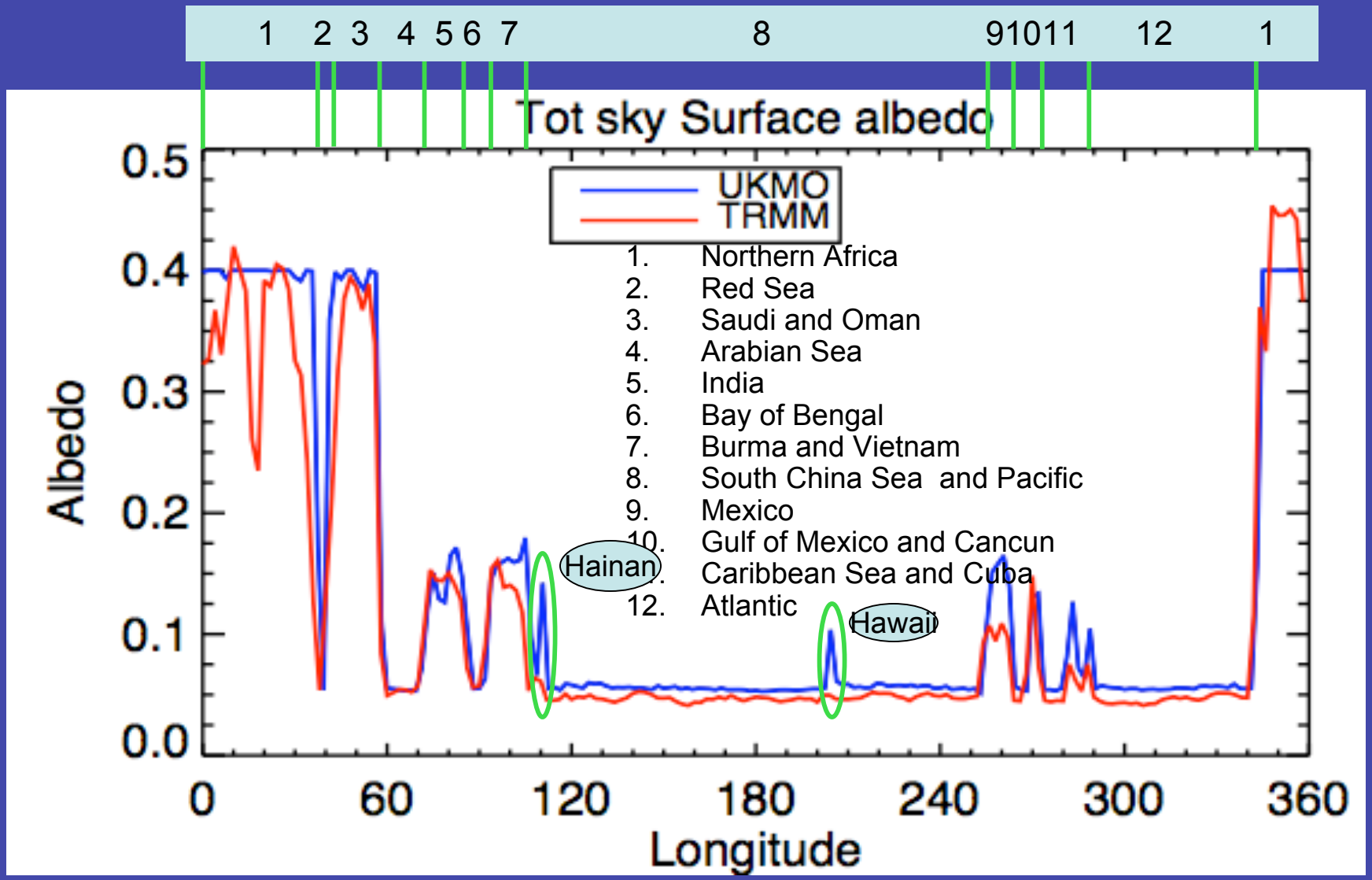
every bin is filled



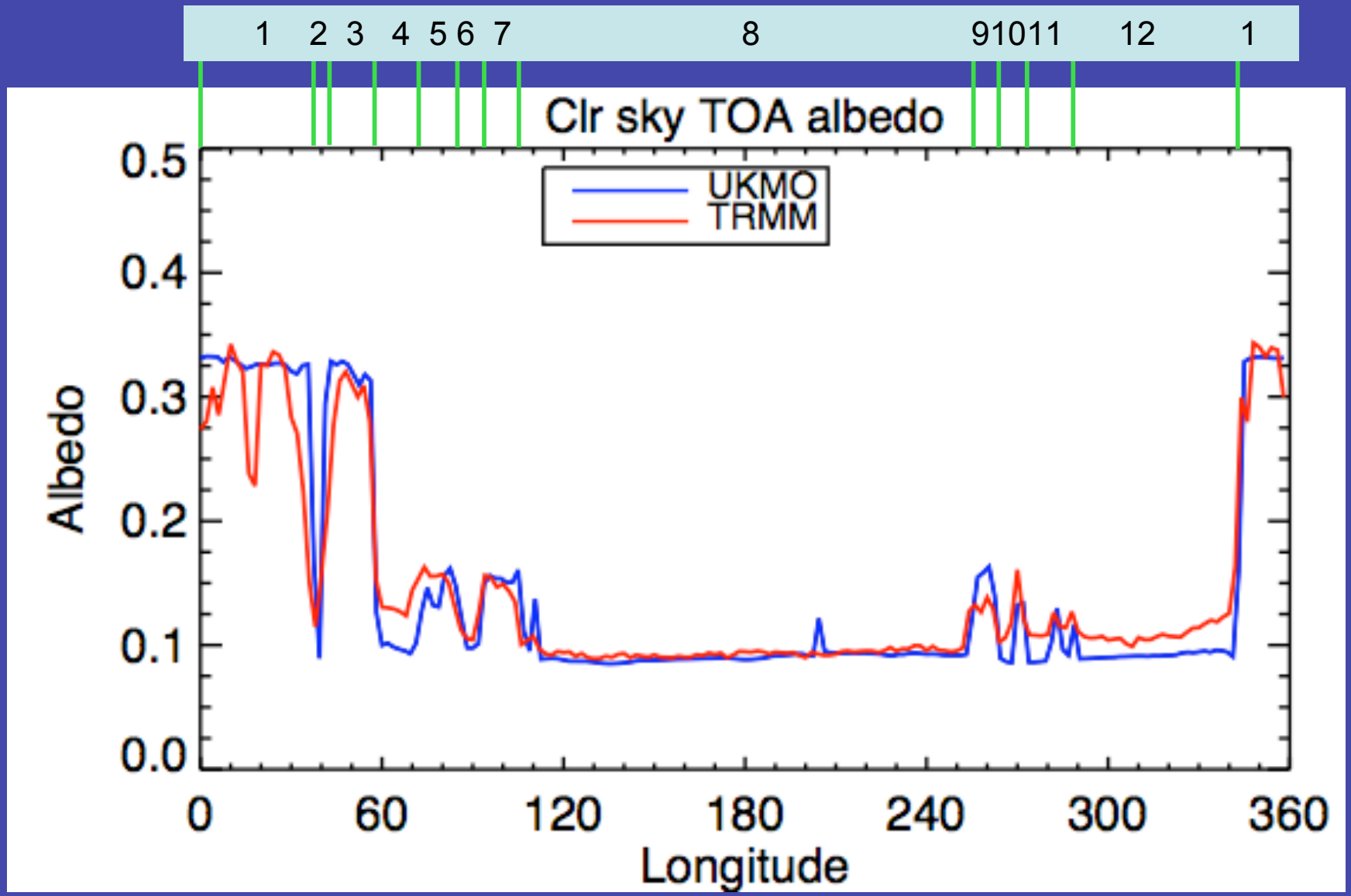
one bin is missing



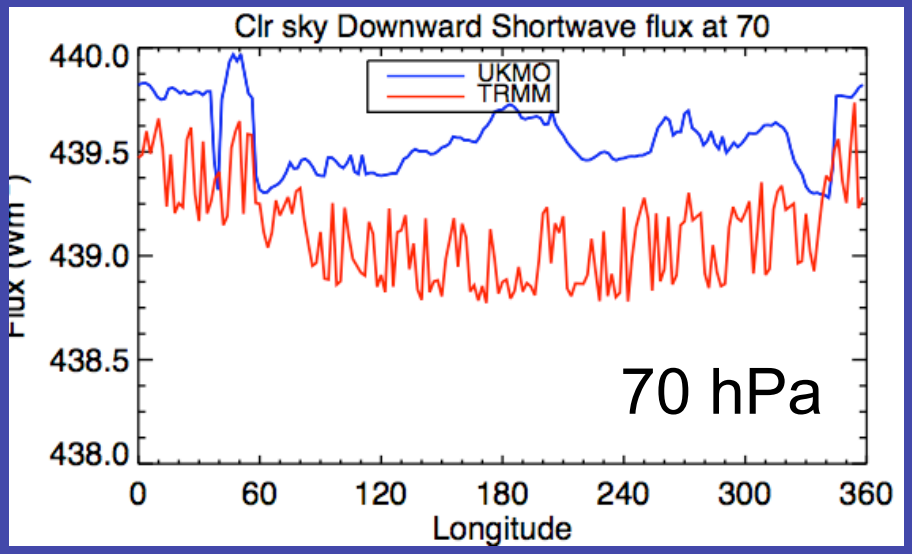
Surface albedo comparison

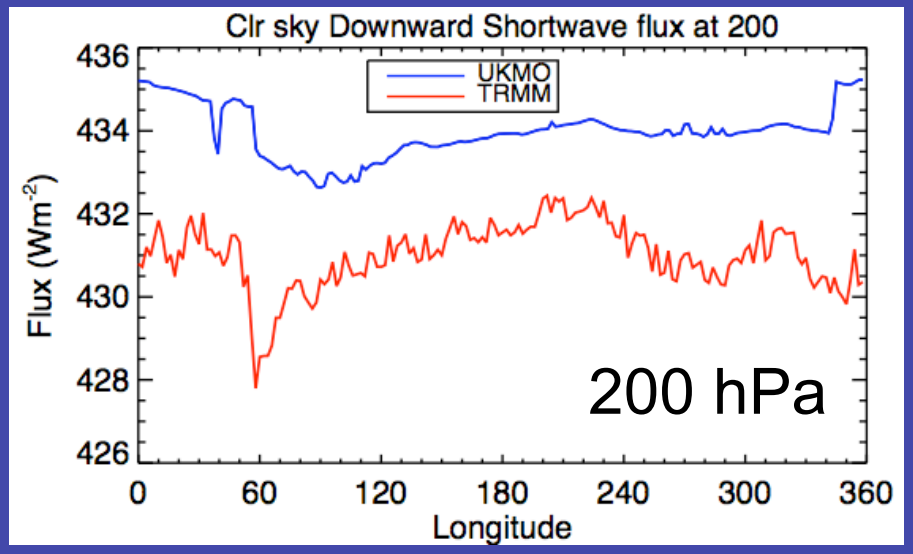


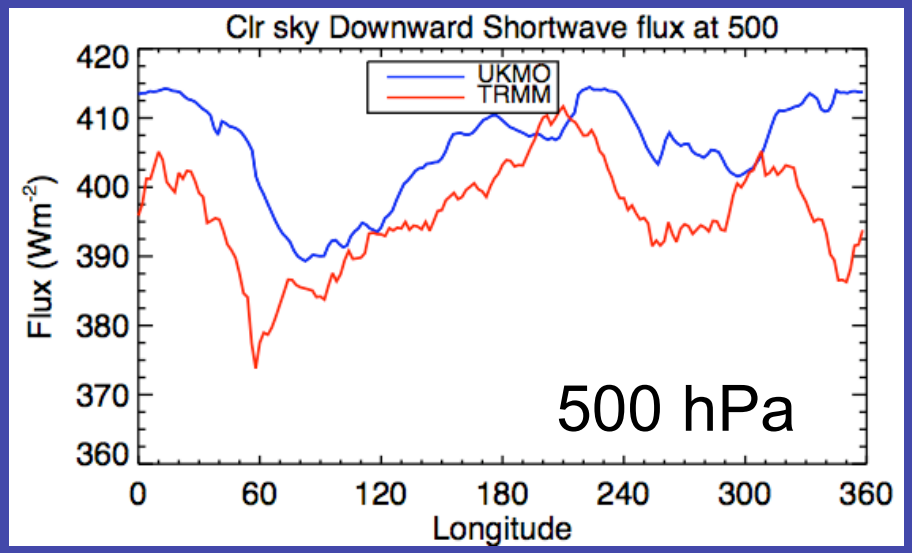
Clear Sky TOA Albedo comparison

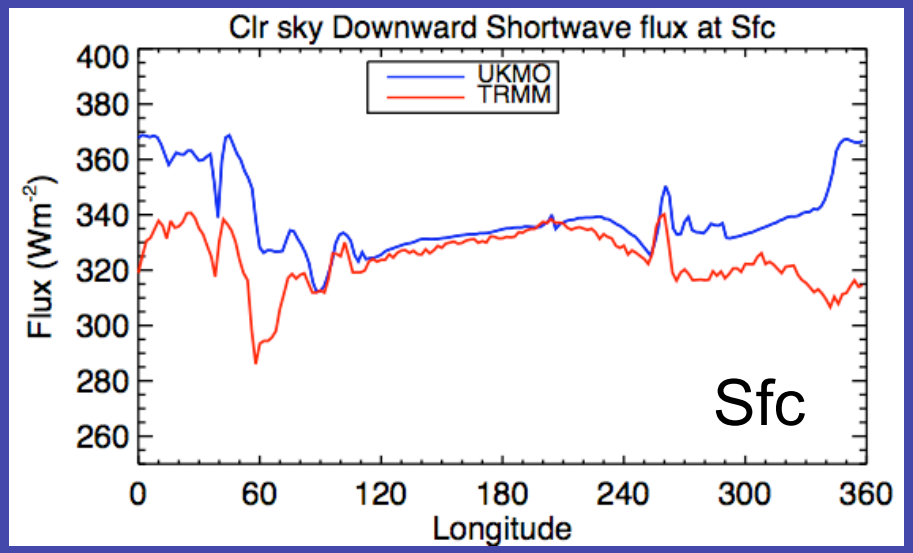


Clear Sky Downward SW Flux

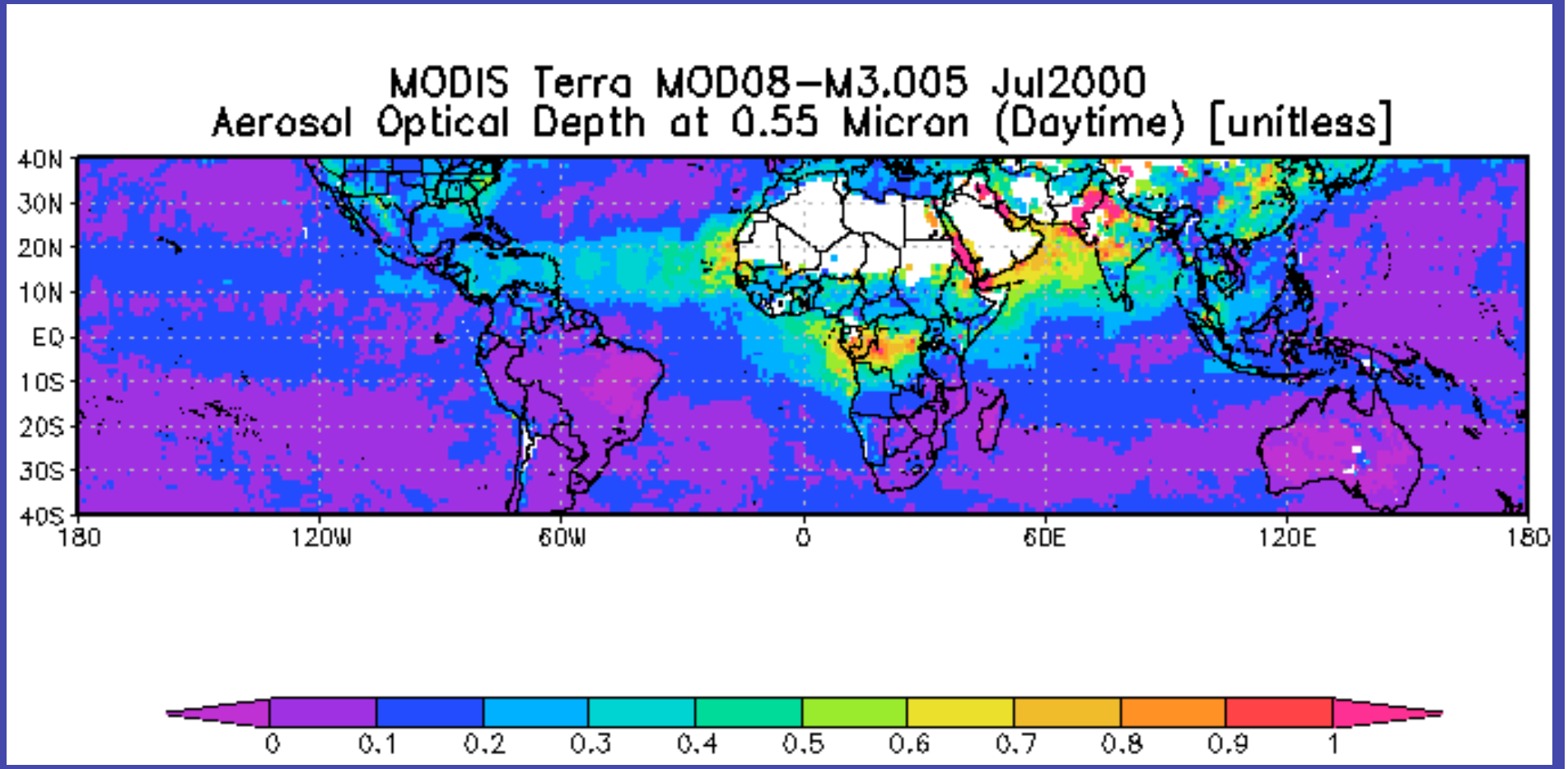






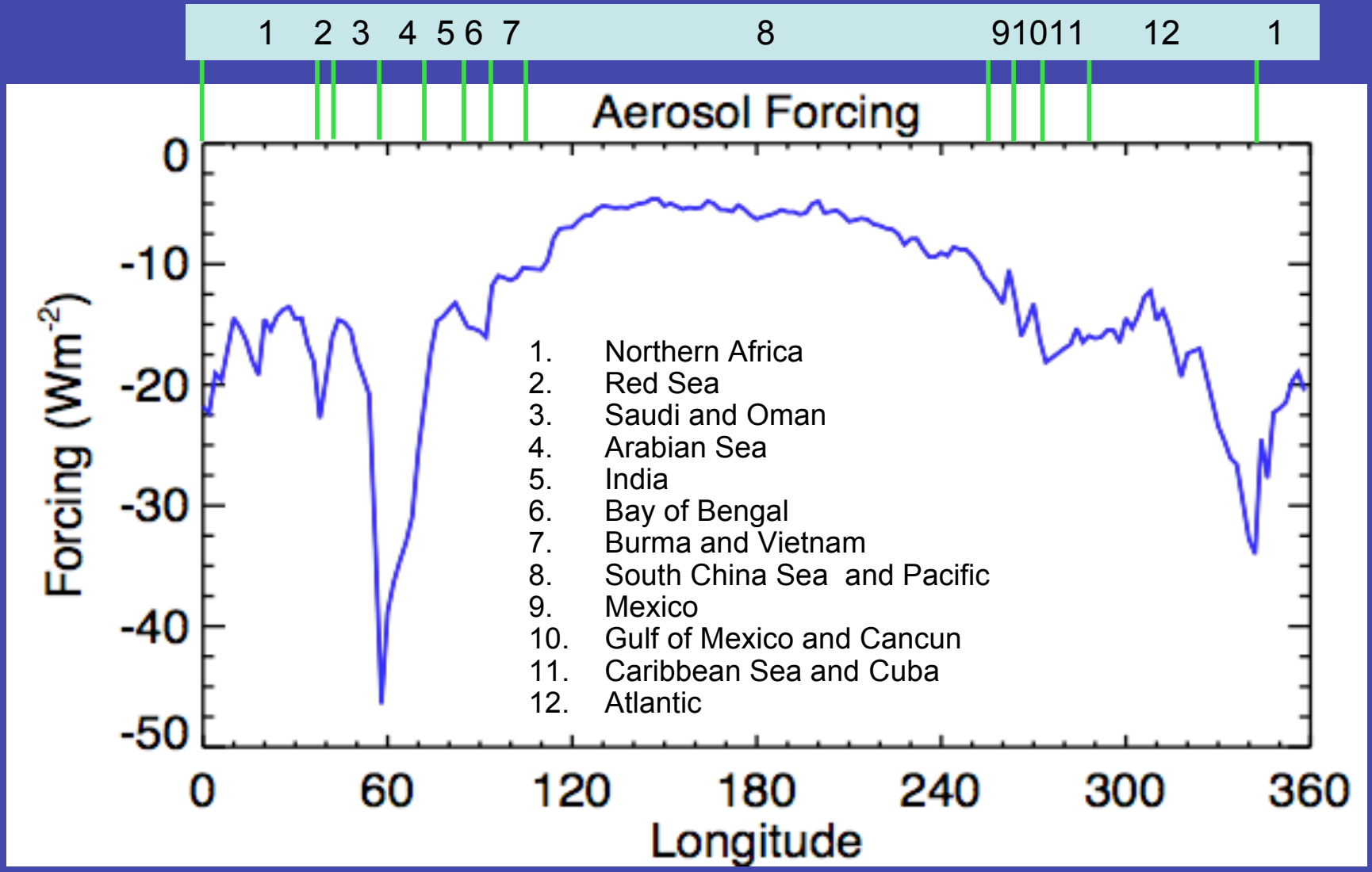


MODIS Aerosol Optical Depth

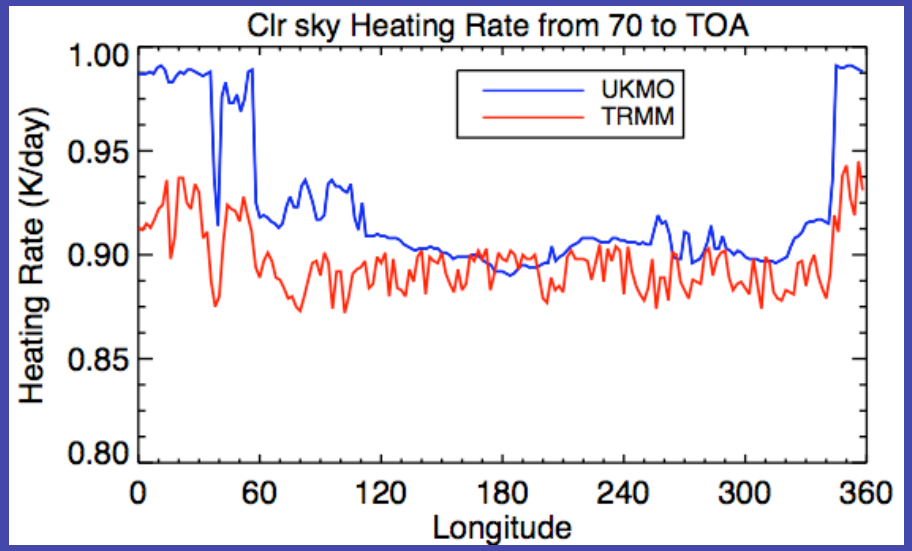


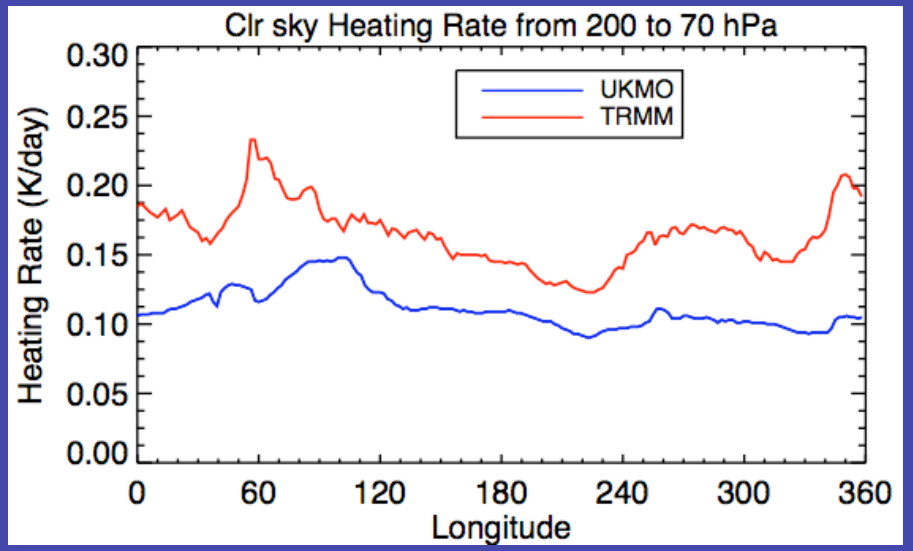
Generated by Giovanni

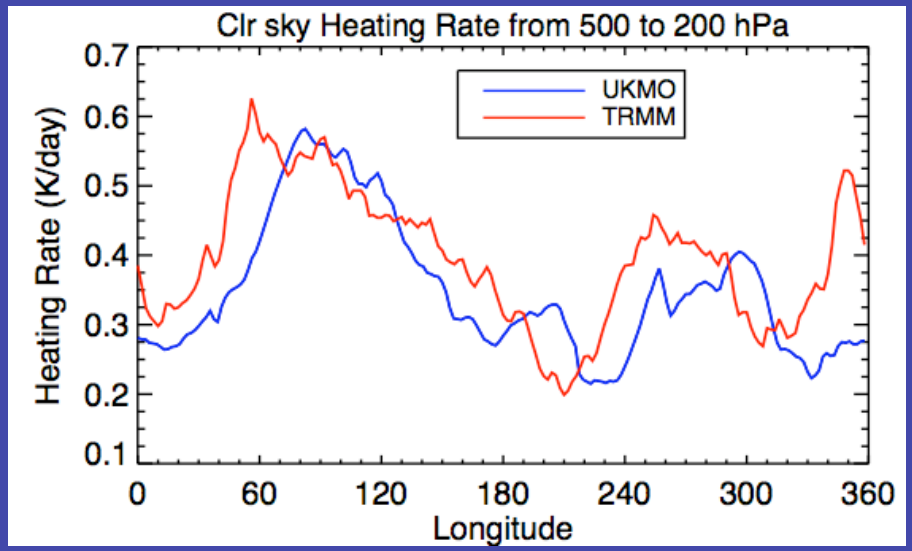
Aerosol forcing from SARB

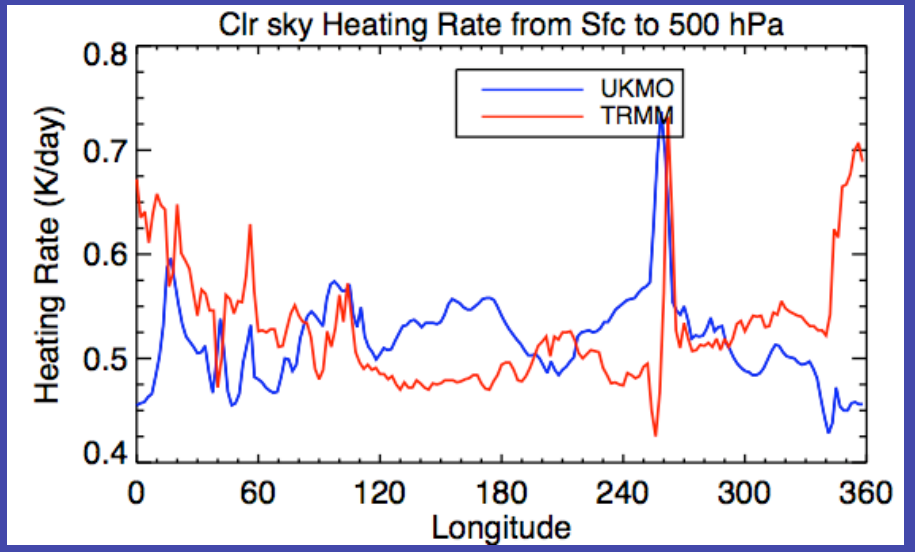


Clear Sky Heating Rate

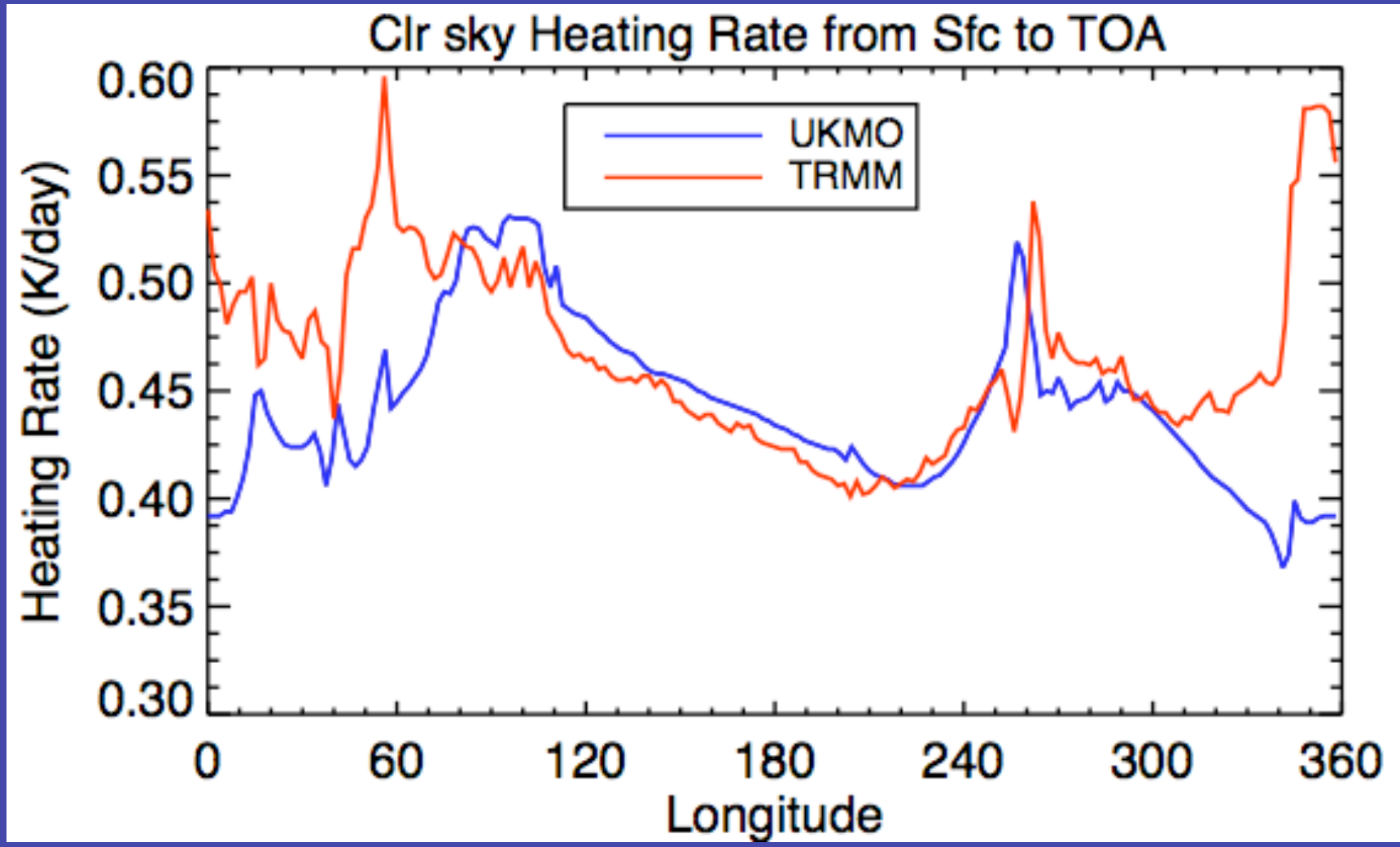




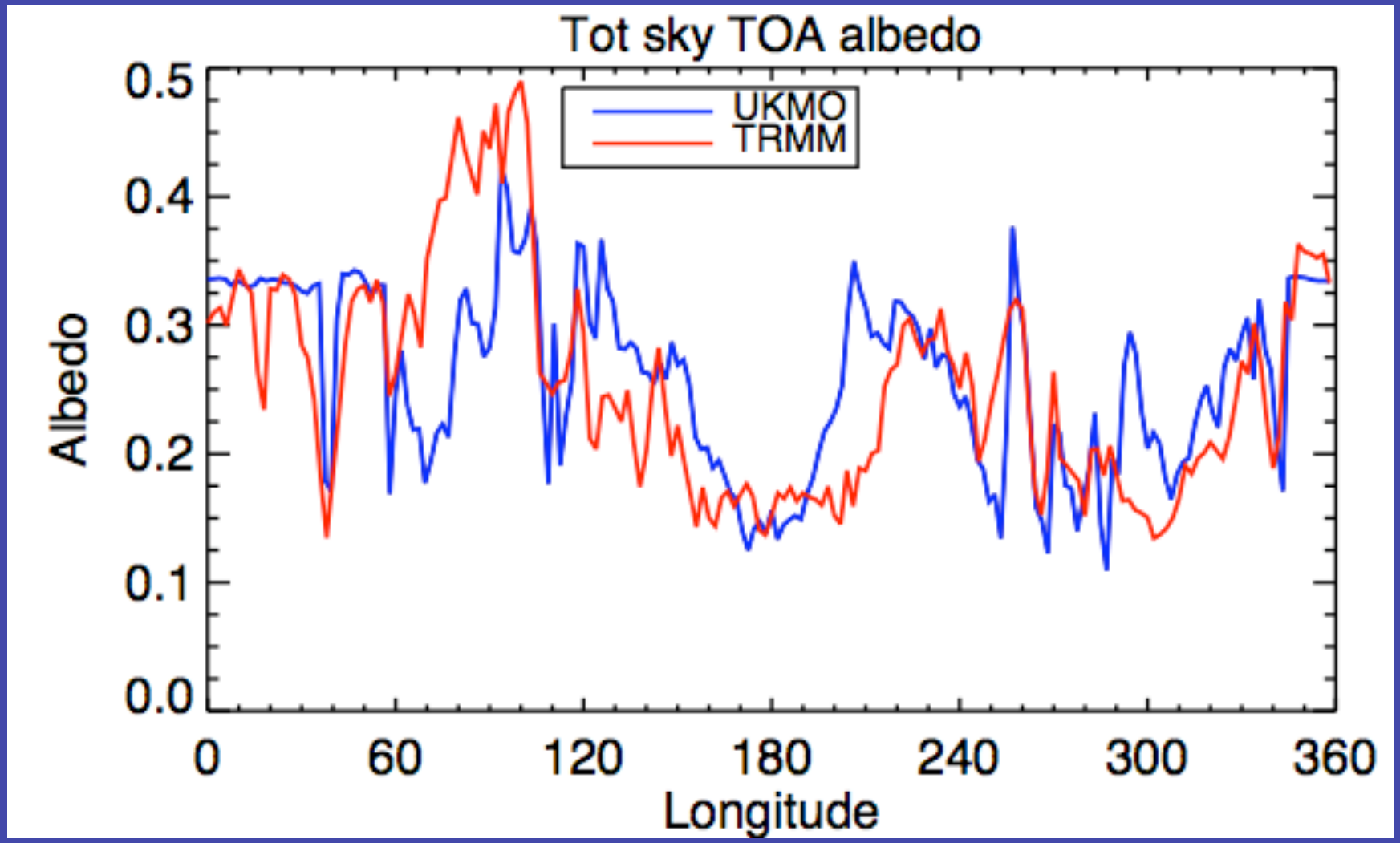




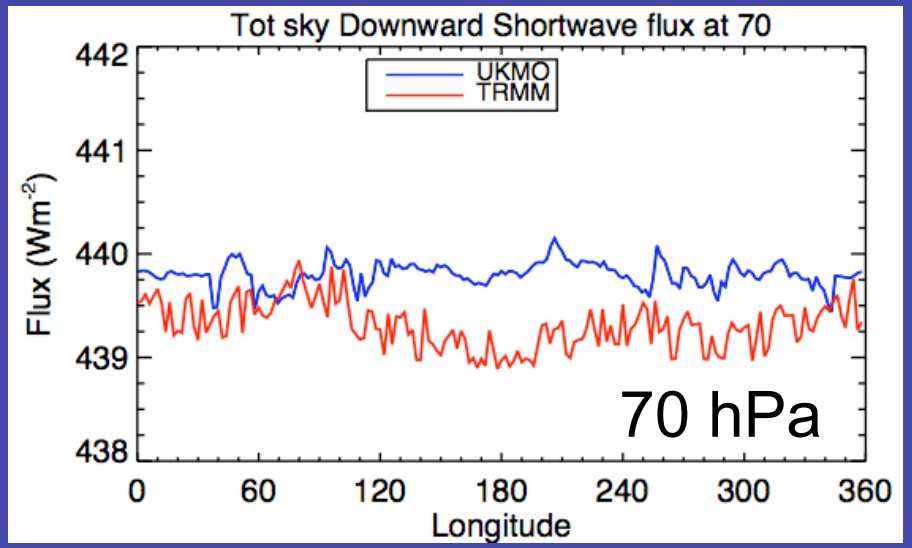
Clear Sky Heating Rate: Sfc to TOA

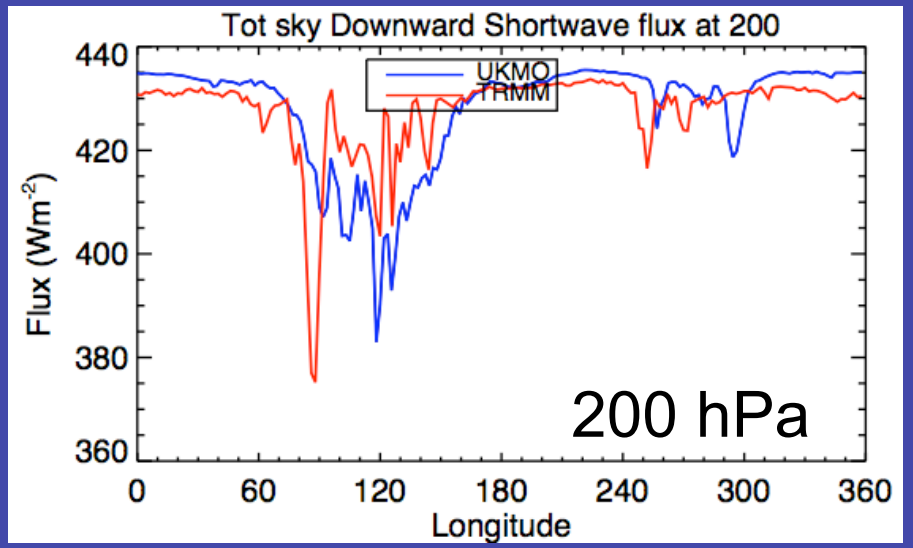


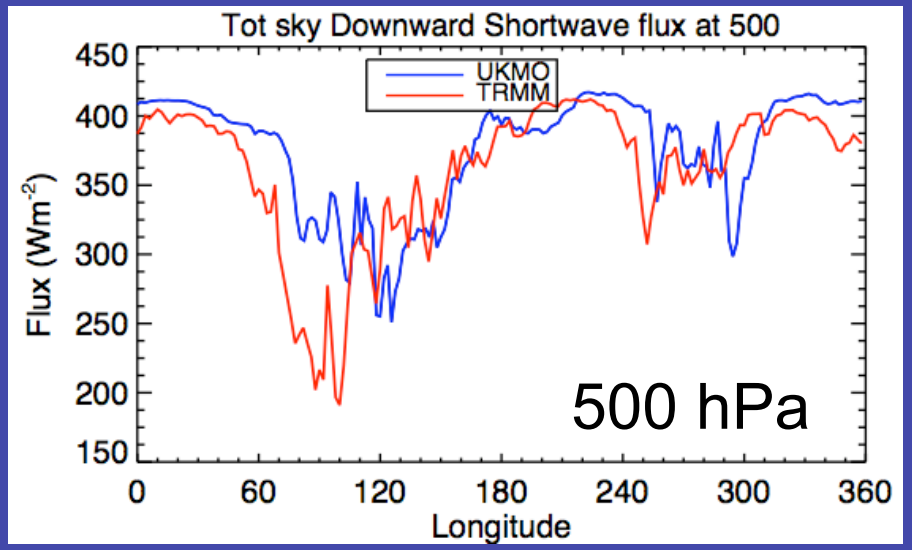
All Sky TOA Albedo Comparison

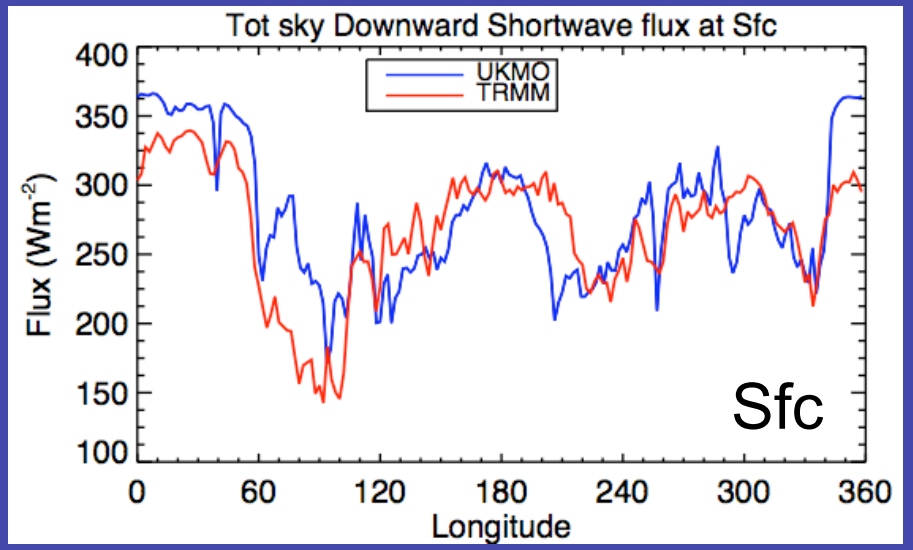


All Sky Downward SW Flux

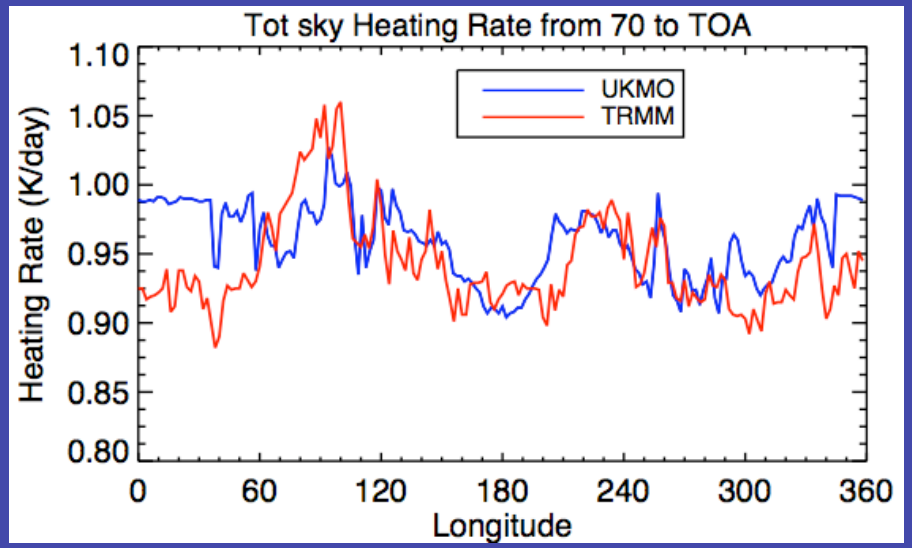


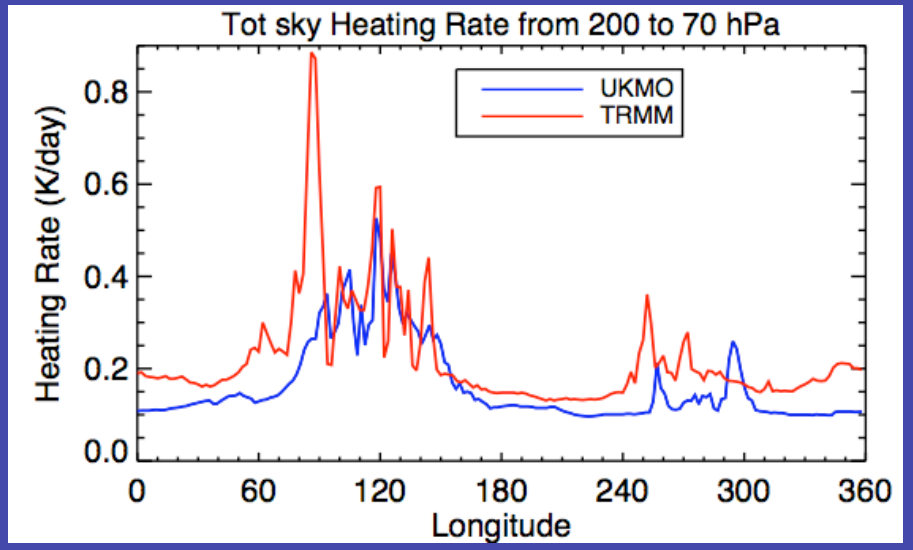


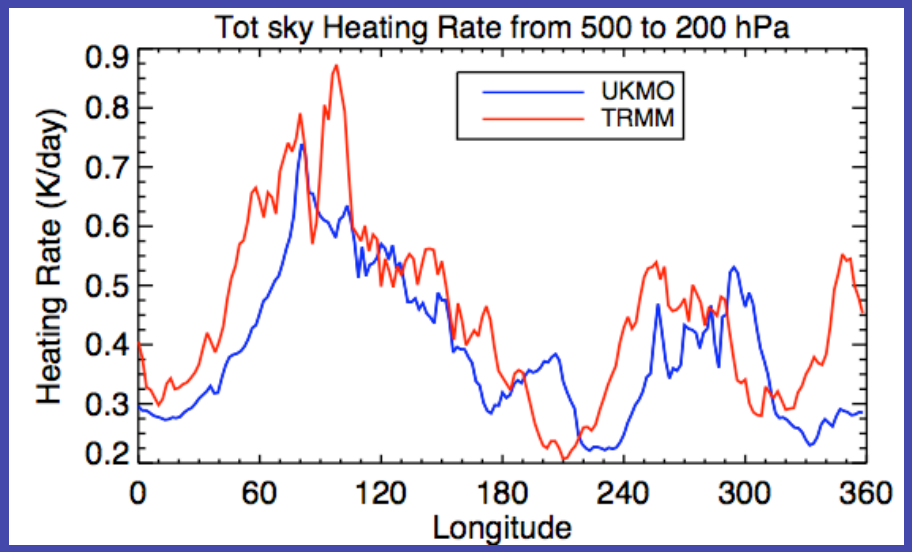


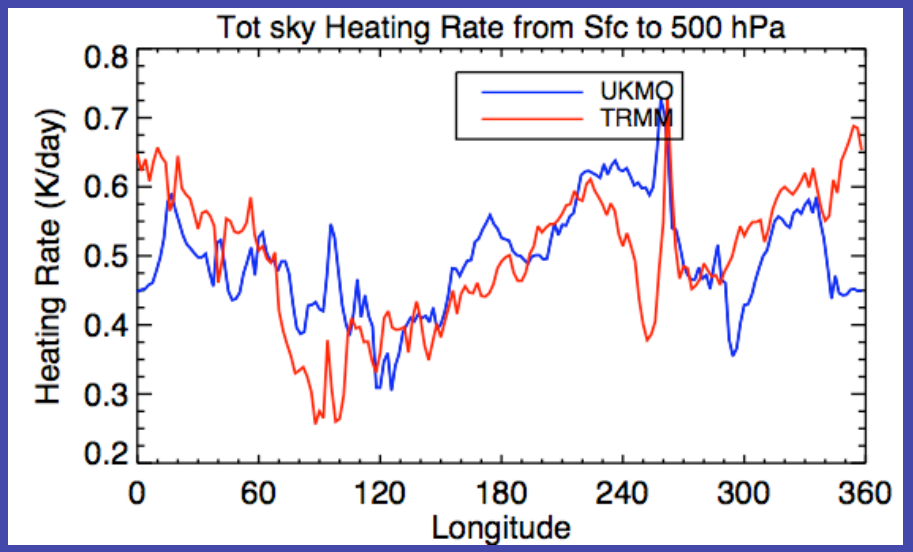


All Sky Heating Rate

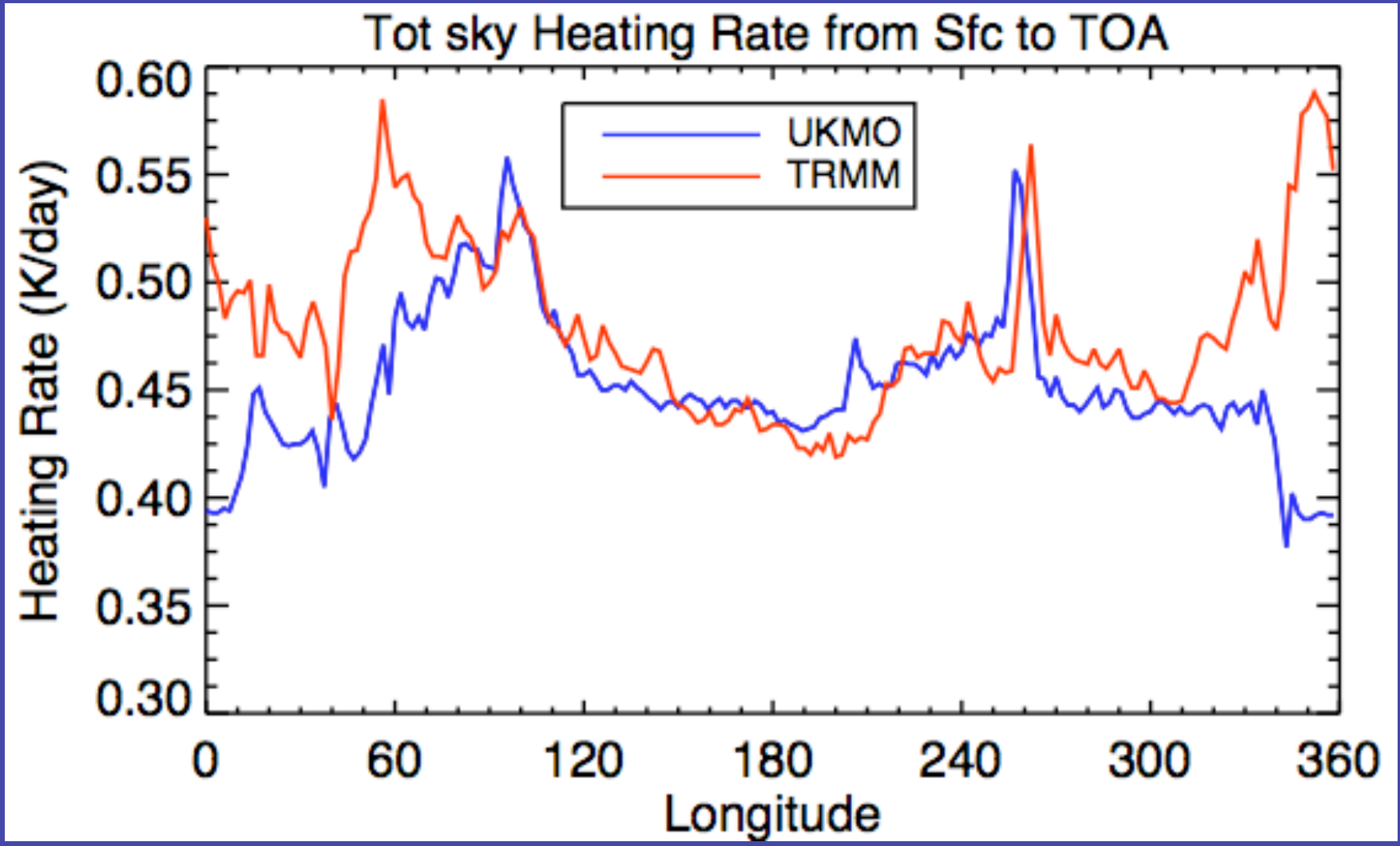








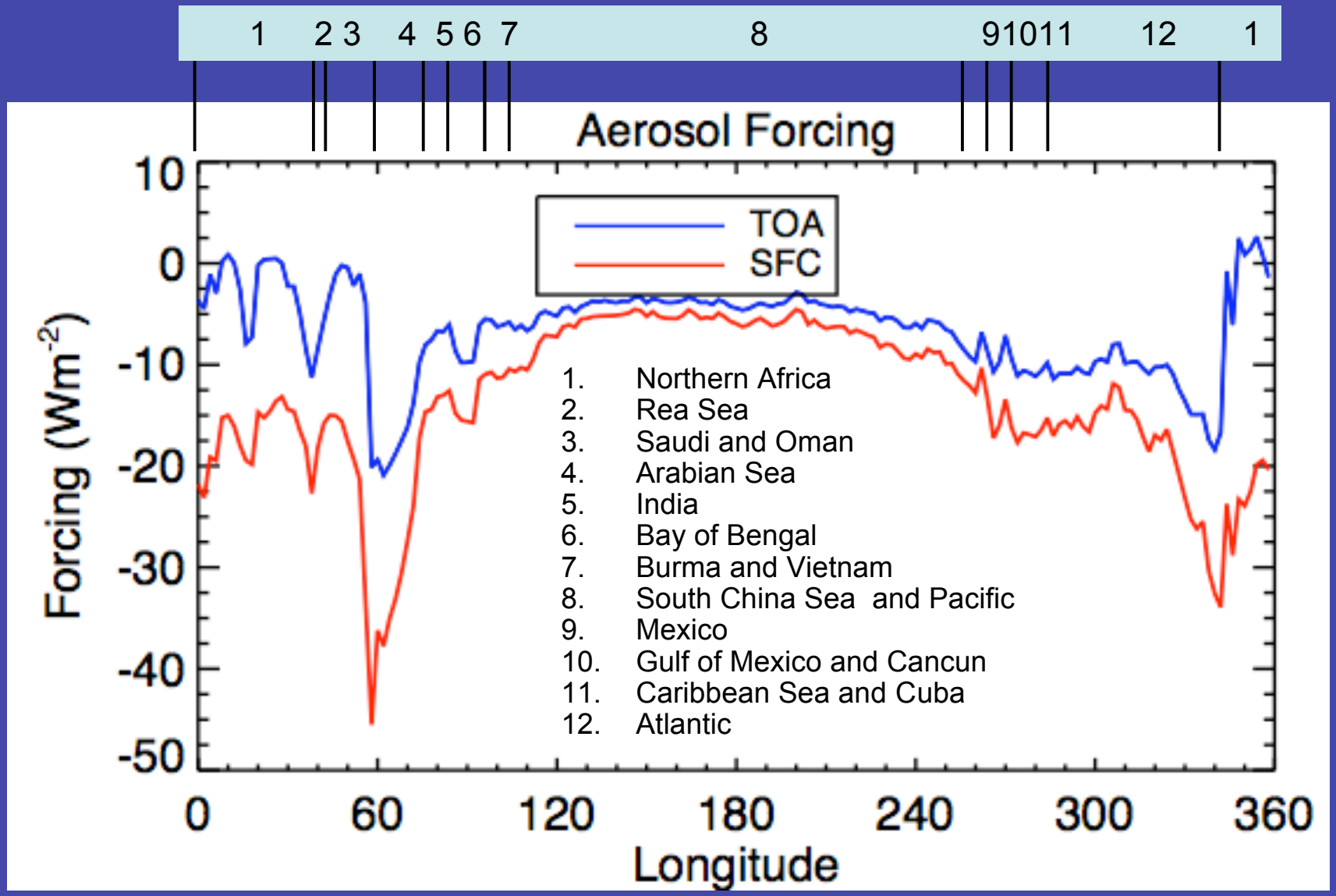
All Sky Heating Rate: Sfc to TOA



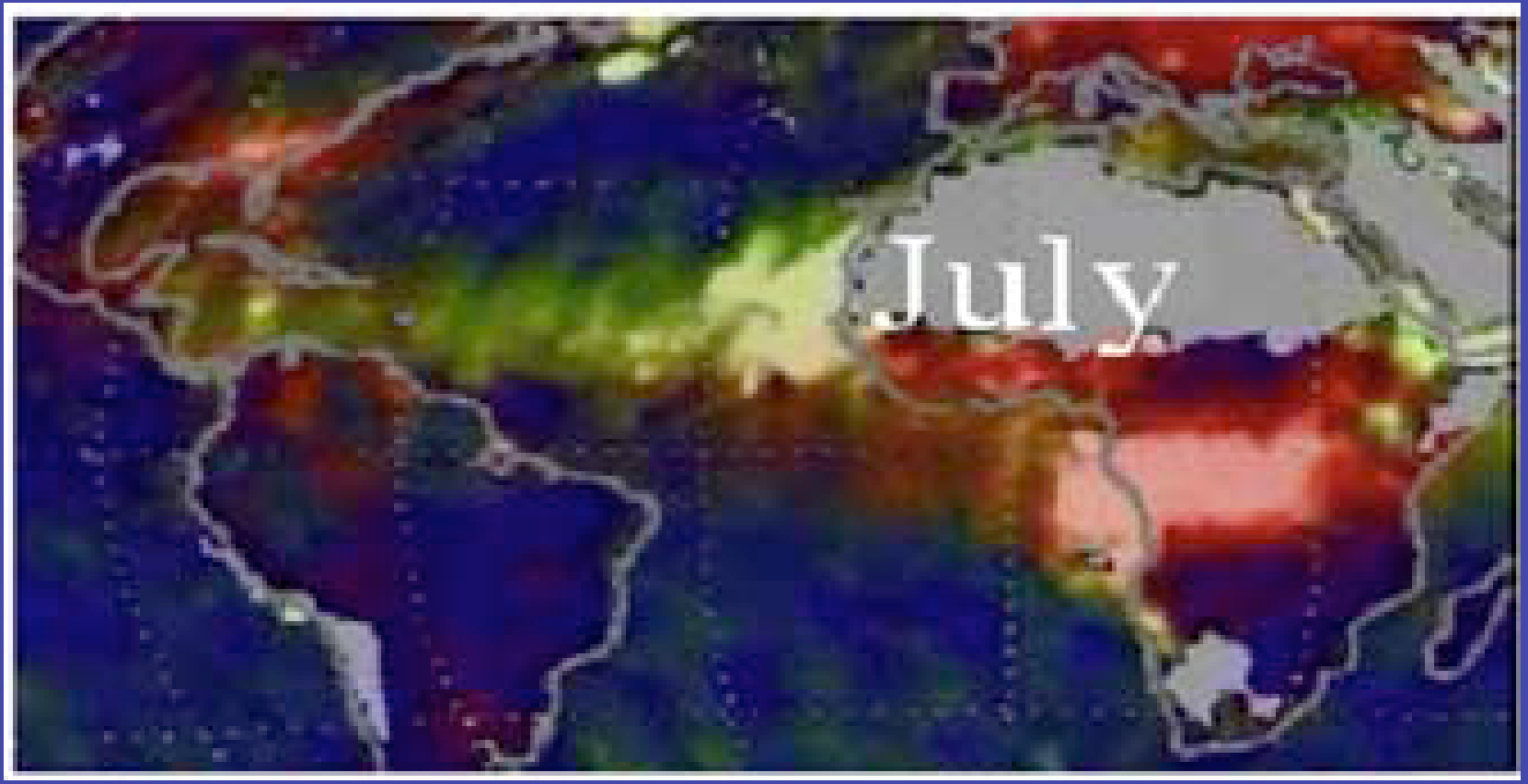
Conclusions

- The CSZA weighting method corrects the TRMM diurnal cycle very well;
- TRMM's surface albedo is smaller than that of the model, except over northern Africa;
- For clear sky, TRMM flux is smaller than model flux at 70, 200, 500 hPa and surface. There is no longitudal variation for 70 and 200 hPa, but for 500 hPa and surface, the difference between TRMM and model is very large over northern Africa;
- For cloudy sky, TRMM and model flux agree well at 70 hPa. TRMM flux is smaller than model flux over the northern Africa, the Arabian sea, and the Atlantic Ocean, and agree well over the Pacific Ocean at 200, 500 hPa and surface.

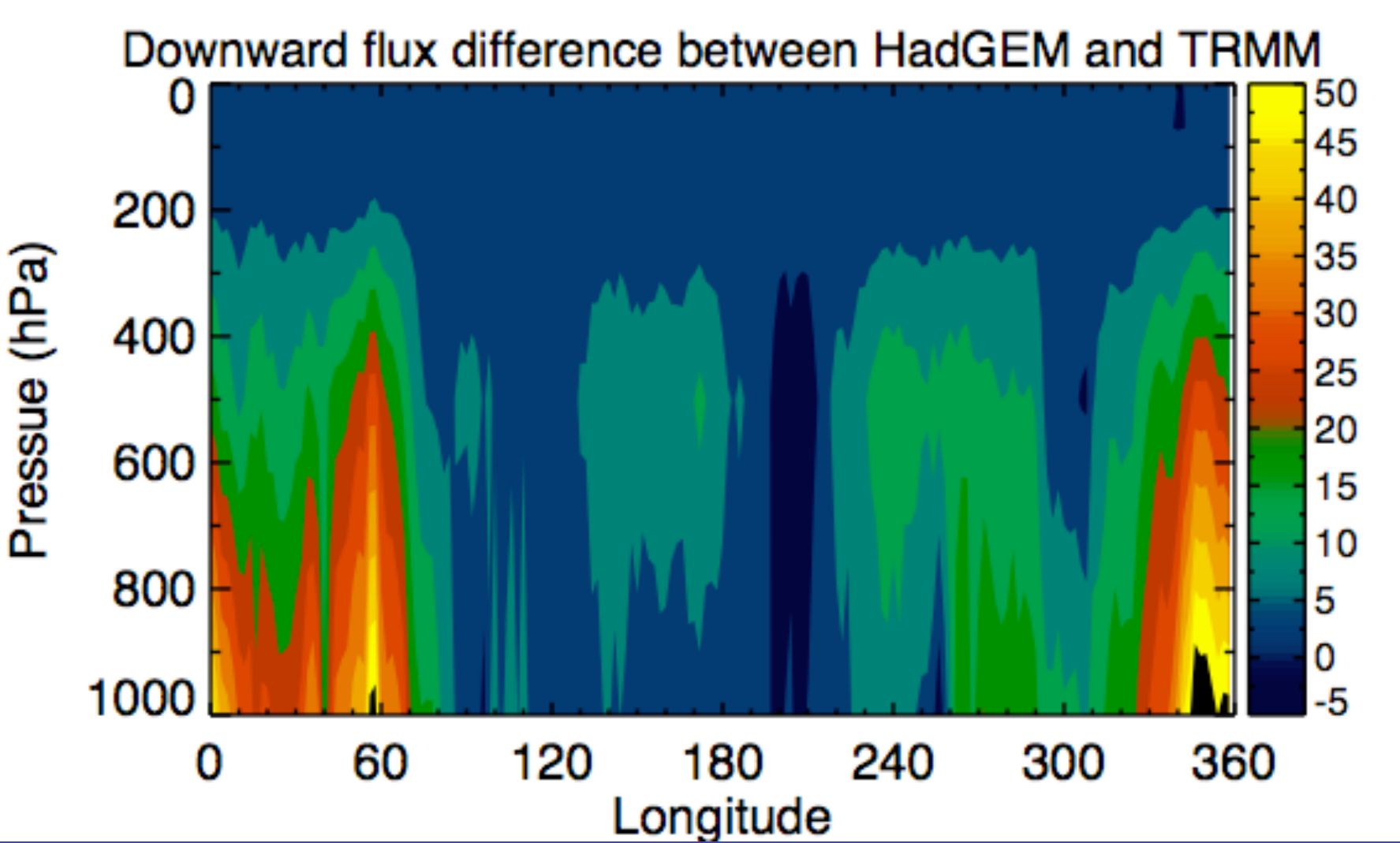
Backup Slides


1 2 3 4 5 6 7 8 9 10 11 12 1
Aerosol Forcing
TOA
SFC
Forcing (Wm-2)
10
0
-10
-20
-30
-40
-50
0
60
120
180
240
300
360
Longitude
1. Northern Africa
2. Rea Sea
3. Saudi and Oman
4. Arabian Sea
5. India
6. Bay of Bengal
7. Burma and Vietnam
8. South China Sea and Pacific
9. Mexico
10. Gulf of Mexico and Cancun
11. Caribbean Sea and Cuba
12. Atlantic

Green is coarse mode aerosol!



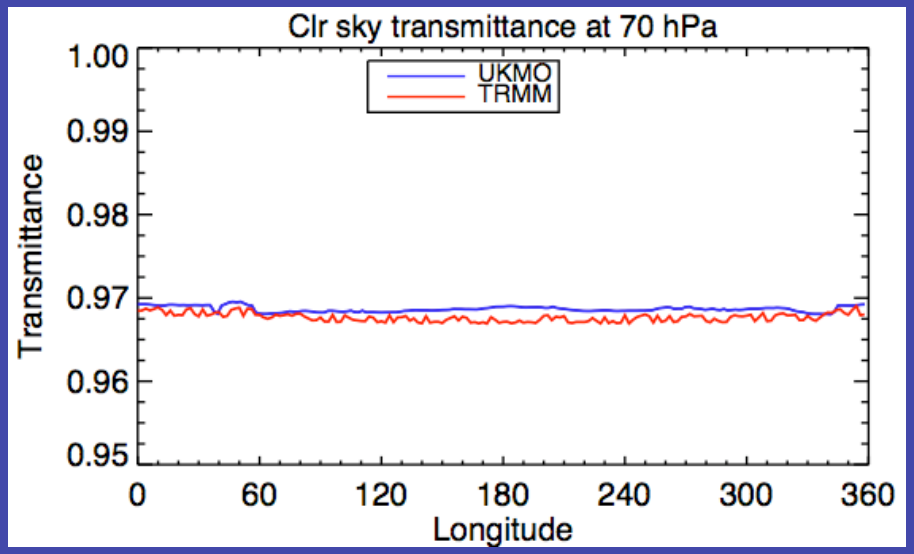
Clear Sky Downward SW Flux Difference

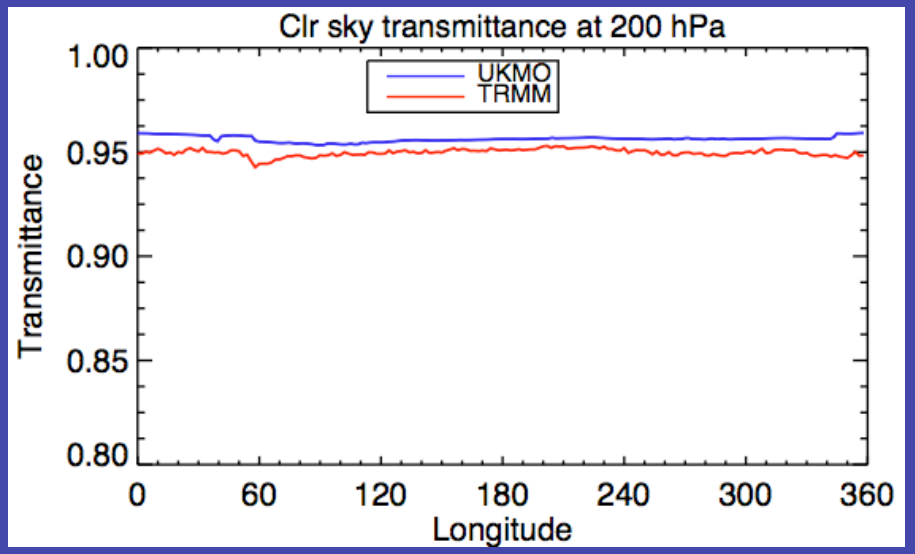


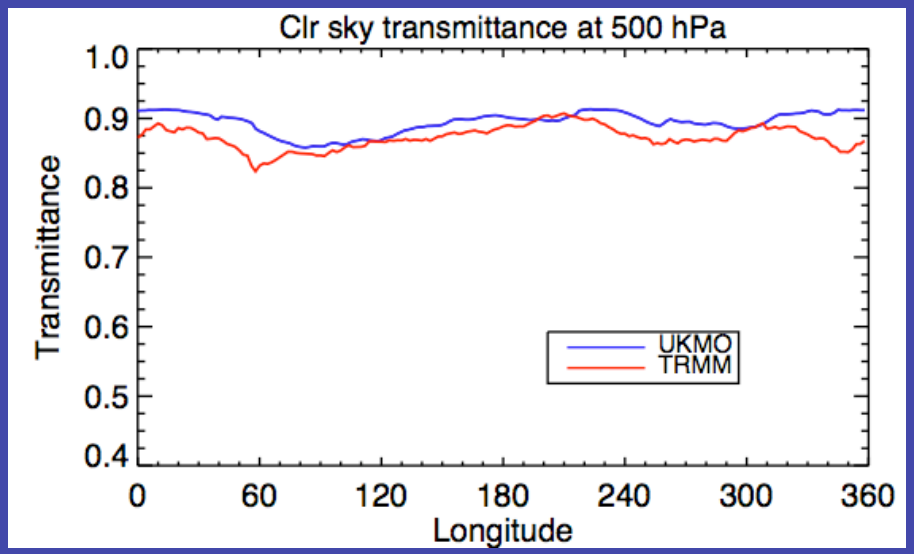
Clear Sky Transmittance: @200 hPa

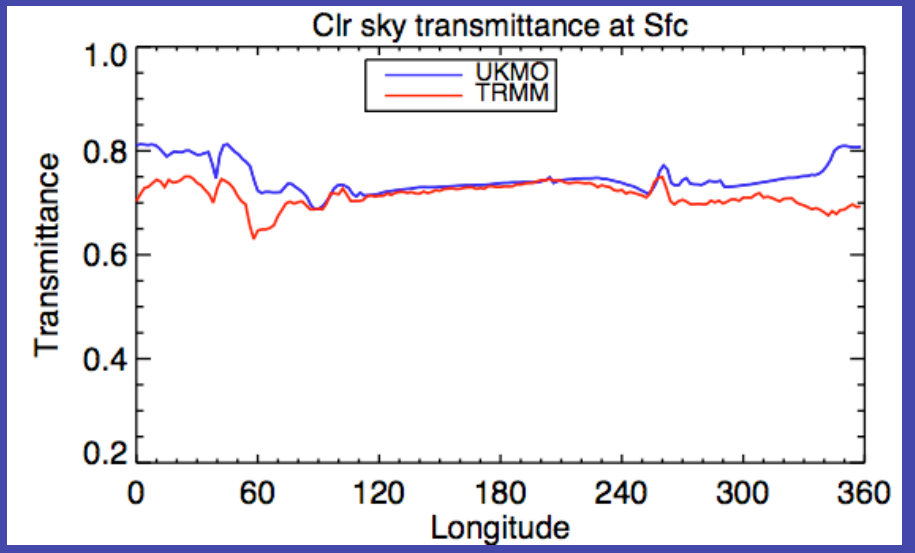
1. Northern Africa
2. Rea Sea
3. Saudi and Oman
4. Arabian Sea
5. India
6. Bay of Bengal
7. Burma and Vietnam
8. South China Sea and Pacific
9. Mexico
10. Gulf of Mexico and Cancun
11. Caribbean Sea and Cuba
12. Atlantic

Clear Sky Transmittance

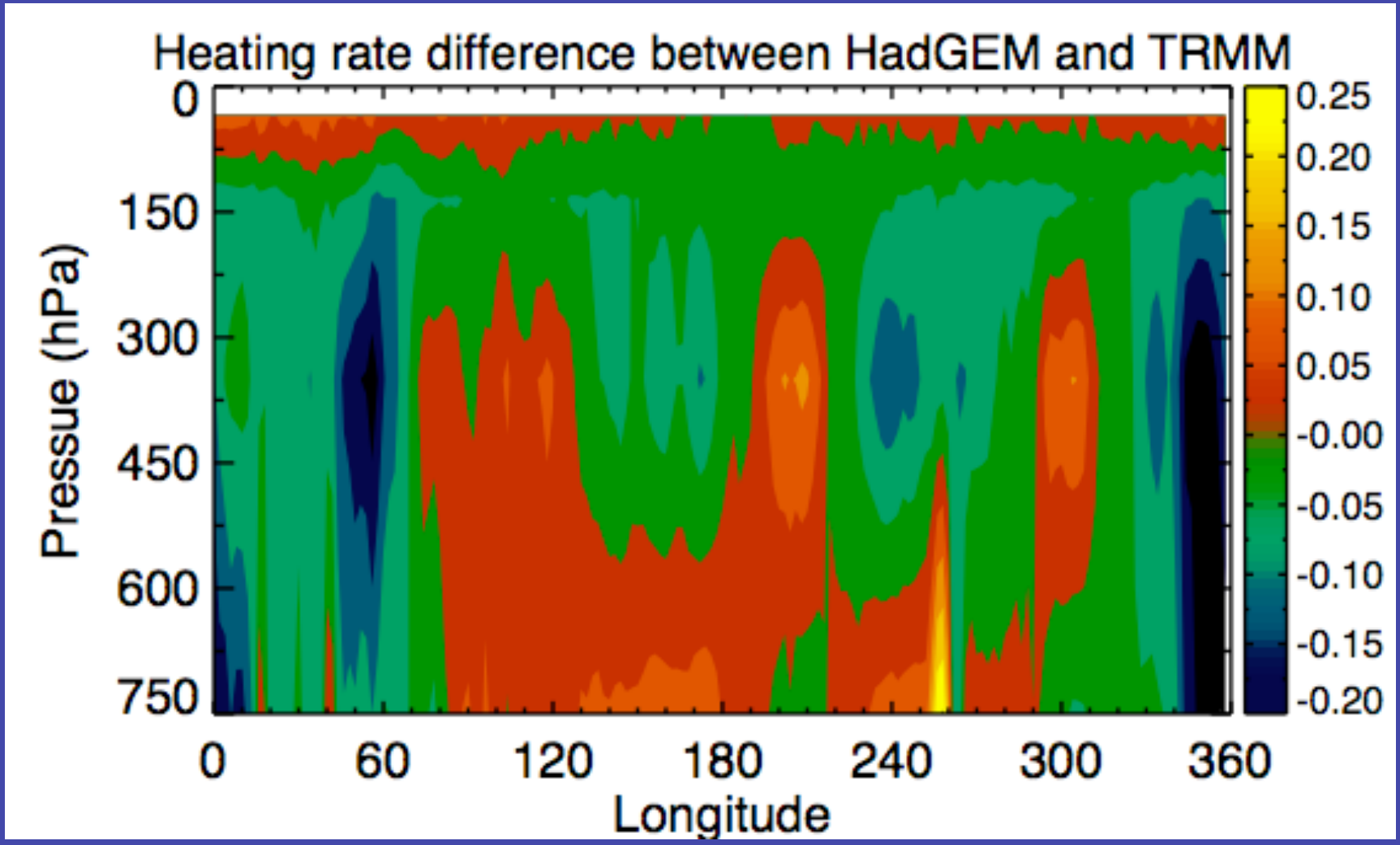




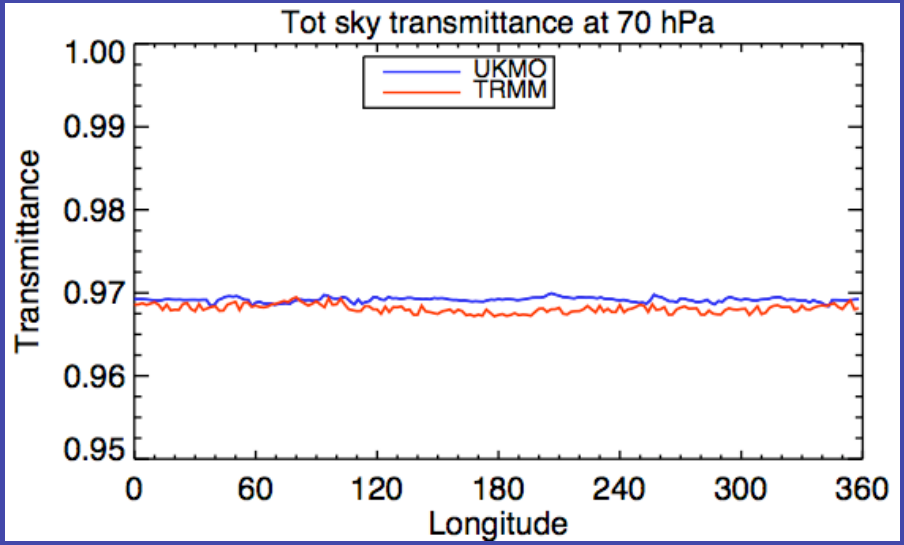


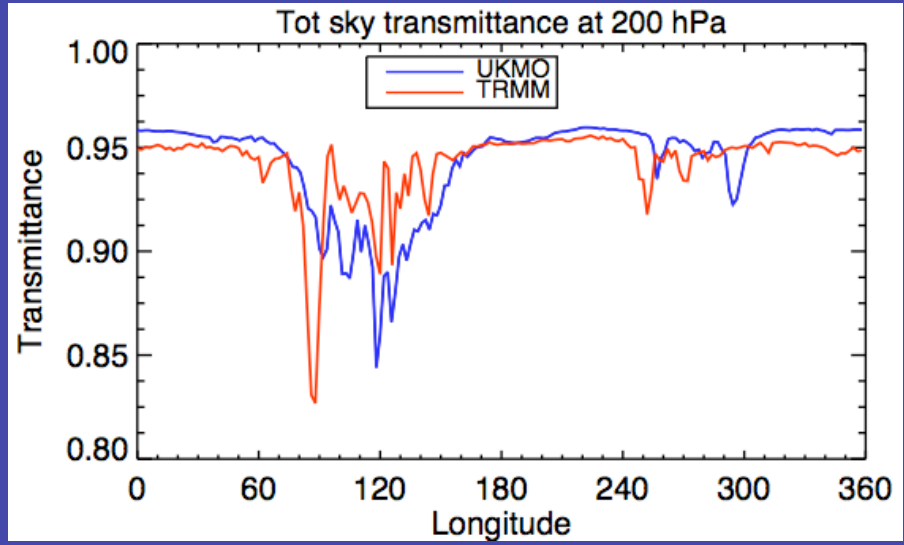


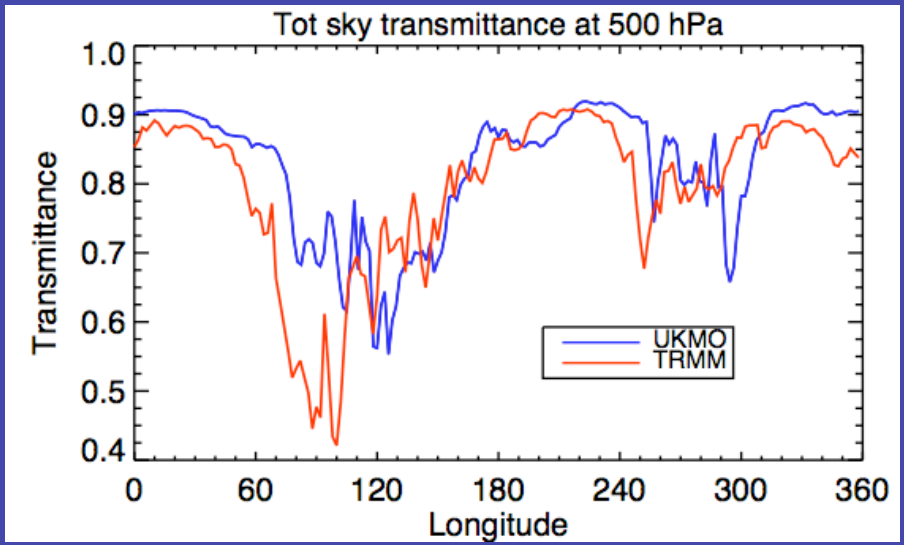
Clear Sky Heating Rate Difference

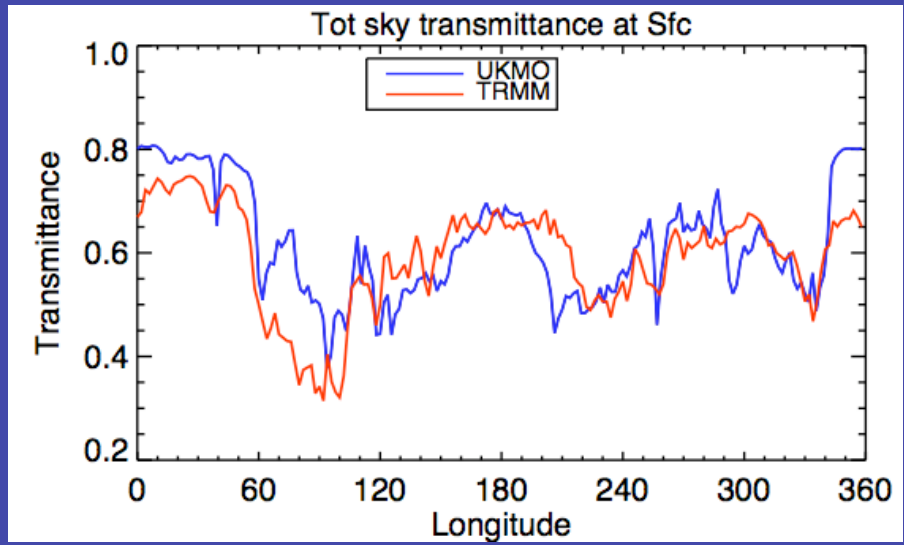


All Sky Transmittance

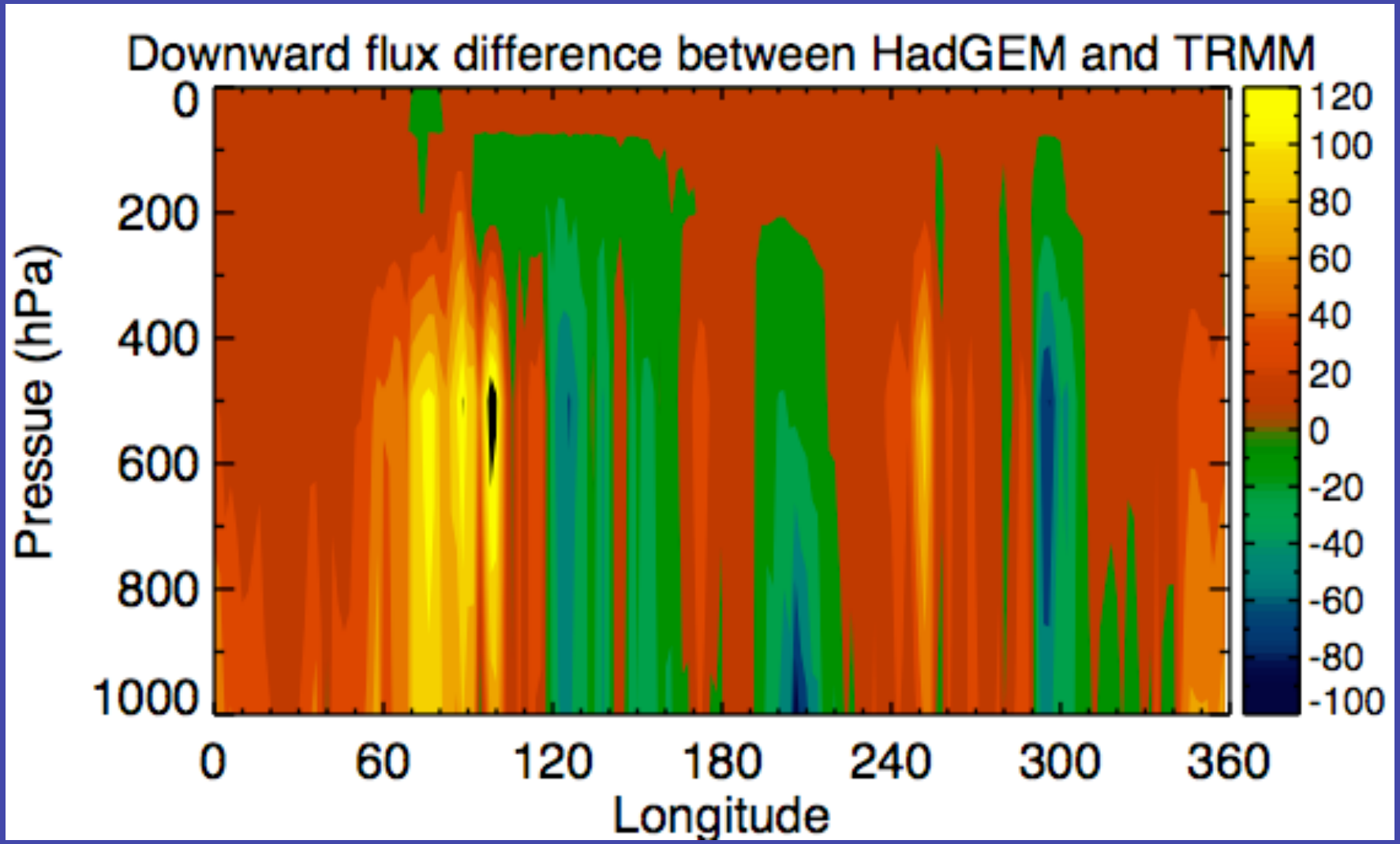








All Sky Downward SW Flux Difference



All Sky Heating Rate Difference